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of elements are independent of each other and were obtained by very different methods, the coincidence can only indicate that the elements found are very near the truth. We may confidently believe that the orbit of *α Centauri* is now as well known as that of any binary star in the heavens. If in the course of time any corrections shall be required for the elements given above, it is certain that the changes will of necessity be very small.

*The University of Chicago :*
1893 *August* 30.

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## *The Periodic Variation in the Motion of 61 Cygni.*

By Harold Jacoby, B.A.

The important discovery by Dr. Wilsing * of a periodic variation in the distance of the components of 61 *Cygni* is of so great interest that it would seem desirable to re-examine the Oxford measures, to see whether additional evidence can be found. The late Professor Pritchard did not measure the distance between the two components directly, as was done at Potsdam. But in his parallax determination he employed two comparison stars (*a* and *b*), which lie very nearly on the great circle joining the two components of 61 *Cygni*. As the distance from each of these comparison stars to such component was always independently measured, we have but to perform a subtraction to get what is very nearly the distance between the two components. In fact, Professor Pritchard himself computed such "differences" for another purpose, and they are printed in his *fasciculus* iii., p. 24, for star *a*, and p. 37 for star *b*. They ought to exhibit a variation similar to that found by Dr. Wilsing from the Potsdam plates. In examining whether such is the case, I have thought it best to treat the results from stars *a* and *b* independently. Professor Pritchard gives also the excess of the mean of all the "differences" over each individual one. I have united these into general means; and to avoid any bias in selecting the several groups for this purpose, I have taken each calendar month by itself, except that the plates of 1886 May 26, 28, 30, and July 1, were included in the group for 1886 June. These were the only plates made in those two months, and their number was too small to use them separately. It is evident that the numbers so obtained will be positive when the distance of the components of 61 *Cygni* is small, and negative when it is large, as compared with its mean value. In this way I find the fol-

* *Kgl. Akad. d. Wissensch. zu Berlin, Sitzungsb.*, xl., p. 879, 1893 Oct. 26.

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lowing as the excess of the mean distance over that actually observed.

| 1886. Date. | No. of Plates. | Star *a*. | Star *b*. |
|---|---|---|---|
| June | 52 | ″·00 | ″+·05 |
| Aug. | 28 | −·07 | −·02 |
| Sept. | 52 | −·01 | −·06 |
| Oct. | 20 | −·01 | +·11 |
| Nov. | 28 | −·03 | +·01 |
| Dec. | 32 | +·01 | +·06 |
| 1887. Jan. | 28 | +·10 | +·05 |
| Feb. | 24 | +·11 | −·15 |
| Mar. | 16 | +·08 | −·04 |
| April | 32 | −·10 | −·08 |
| May | 44 | −·01 | +·05 |

This table indicates, with comparatively good agreement between the two independent determinations *a* and *b*, that the distance of the components of 61 *Cygni* was less in 1887 January than it had been in 1886 September by about 0″·12. Just such a diminution of the distance in four months was found by Dr. Wilsing to precede minima in 1891 June and 1893 April. Moreover, Professor Pritchard's results agree fairly well with Dr. Wilsing's in showing an indication of steadiness for some months preceding the minimum, and a sharp rise, with perhaps a subsequent slight fall, some three months or so after the minimum. If the minimum observed at Oxford is taken to have occurred in 1887 January, we can compare it with Dr. Wilsing's of 1893 April, to determine the period. The interval would give a period of twenty-five or nineteen months, according to whether we assume that three or four periods had elapsed. Dr. Wilsing makes the period twenty-two months from his own two observed minima. The period may therefore be variable.

On the whole we may conclude that the above evidence furnished by the Oxford observations is favourable to the reality of Dr. Wilsing's discovery. I have also examined in a similar way the Oxford measures of the comparison stars *c* and *d*, which are situated in a direction approximately at right angles to the great circle joining the two components of 61 *Cygni*. The numbers, however, come out smaller, and with more frequent changes of sign, so that no conclusion can properly be drawn from them.

*Columbia College Observatory, New York:*
1893 *November* 27.

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## *The Orbit of γ Andromedæ* BC. By S. W. Burnham, M.A.

For nearly forty years after the discovery of this pair by Otto Struve in 1842, the measures failed to show any considerable change in either angle or distance. The observations are very discordant, and for many years it was impossible to say anything more than that an increase in the distance of perhaps one or two tenths of a second was probable; while change in the angle was at least doubtful so far as the measures were concerned. Some ten years ago it was evident that the distance was decreasing, and it finally came to be regarded as single in most telescopes. I found it very close with 36-inch refractor at Mount Hamilton, but made some measures of both angle and distance in 1889, and again in 1891 obtained three fairly satisfactory measures of the angle, the distance being estimated at not more than $0''.05$. It was also examined in 1888 and 1890, but the star was too close, or the conditions too unfavourable, to make it possible to get any measures.

From the uncertain and discordant character of the earlier measures, it was impossible to tell to which quadrant the smaller component belonged in my measures of 1891, and therefore the form of the apparent orbit was still uncertain. During the past summer I requested Professor E. E. Barnard to observe this pair with the 36-inch telescope, and especially to be certain of the quadrant. I have recently received from him his measures, made on two nights under favourable conditions. On both occasions he was absolutely certain that the smaller component was on the following side. The stars were well separated with a power of 2,600, and the difference in magnitude was unmistakable. I have given the highest value to these measures.

This position furnishes the key to the situation, and without it would be impossible to even guess at the form of the apparent orbit. With the large arc passed over by the smaller star, a reasonably good provisional orbit should now be obtained. According to the Mount Hamilton measures, this star has moved about 330° in the last four years.

The following are the measures of this pair:

*Measures of γ Andromedæ BC.* (OΣ 38).

| | | | | |
|---|---|---|---|---|
| 1843·00* | 119°·7 | 0″·45 ± | 2*n* | Dawes |
| ·19* | 119·8 | 0·35 | 2–1 | Mädler |
| ·55* | 125·5 | 0·48 | 3 | O. Struve |
| 1845·15* | 116·9 | 0.39 | 4 | Mädler |
| 1846·64* | 111·3 | 0·43 | 7–3 | Mitchel |
| 1847·13* | 117·9 | 0·52 | 5 | O. Struve |

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